GRAINS FOR THE DRY LANDS OF CENTRAL OREGON

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THIS bulletin discusses the production of small grains on nonirrigated lands in central and southeastern Oregon at elevations between 4,000 and 5,000 feet. The important crops for these dry-farmed lands are winter wheat and rye and spring wheat, rye, oats, and barley. Field peas are also of value as a legume for forage and grain. Dependence upon grain farming alone, however, is not advisable in this region; the grain crops should be grown for the winter feeding and the finishing of stock that are grazed on the near-by range.

The average annual rainfall in this section is about 11 inches, which usually is sufficient to produce crops on good soil which is well farmed. The principal drawback to crop production is the frequency of summer frosts. The nights are nearly always cool and frost may occur in any of the summer months. The frost-free period is seldom more than 40 or 50 days.

Winter wheat is the best of the cereal crops, especially on the valley silt loams and the plateau fine sandy loams. It should be sown on summer fallow at the rate of about 30 pounds to the acre. Only the hard red varieties, such as Turkey and Crimean, should be grown. When there is not sufficient moisture in the autumn to germinate winter wheat, spring wheat should be sown.

Rye is the principal crop now grown in central Oregon. Usually more grain is produced when it is sown in early spring than in the fall, for it is later in heading and more often escapes summer frosts.

Because of the distance from market and the low price per pound which can be obtained for oats and barley as compared with wheat, these grains should be grown only for feeding on the farms where they are produced. Sixty-Day oats and White Smyrna barley are the best varieties of these grains to grow.

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PLACE OF THE GRAIN CROPS IN CENTRAL OREGON.

The future of the dry lands of central Oregon lies in a combination of crops with stock. The cultivated land will be used to produce feed for wintering and finishing stock that are grazed on the near-by range, only the surplus crops being sold. This will make dry farming succeed where otherwise it would be impossible.

In such a system of farming the growing of grains has a very important place. This bulletin therefore gives general information, based partly upon experiments at the Harney Branch Experiment Station at Burns, Oreg.,[1] concerning the production of the small grains on those nonirrigated lands of central Oregon which lie at altitudes between 4,000 and 5,000 feet. To lands which have the water table at a depth of 10 feet or less or which can be irrigated, the contents may apply in part. They apply only where the rainfall, summer frost, and winter cold are average and where the nature, depth, and alkali content of the soil are favorable for crop production. Market limitations and the needs of individual farmers are important factors also in determining the choice of crops among those that can be grown.

The important cereal crops for these dry-farming lands as a whole are winter and spring wheat, winter and spring rye, spring oats,

[1] The Harney Branch Experiment Station was established at Burns, Oreg., in 1911. Harney County appropriated funds for the purchase of land, the erection of buildings, and the purchase of equipment. The work is conducted cooperatively by the Oregon Agricultural Experiment Station and the United States Department of Agriculture. Three years' results have now been obtained on summer-fallowed land.

and spring barley. Flax, field peas, and dry-land alfalfa are also of importance, but their place is not yet fully determined. Crops of minor importance which can be grown are emmer, spelt, rape, sweet clover, root crops, and potatoes. Crops which have been rather definitely proved to be unadapted to the average conditions are corn, millet, sorghum, beans, buckwheat, and cultivated grasses. Any crop which requires more than a very short growing season and is not resistant to frost and drought should not be attempted in more than an experimental way.

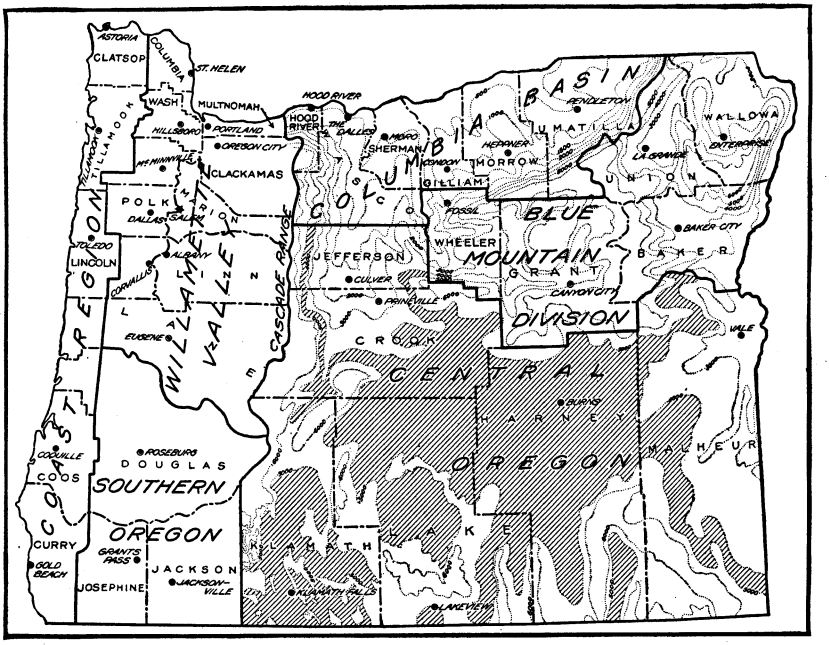

FIG. 1.—Map of Oregon, showing the principal divisions of the State, with contour lines up to 6,000 feet east of the Cascade Range. The shaded portion of the map shows the section to which this bulletin particularly applies, that part of central Oregon with altitudes between 4,000 and 5,000 feet.

DESCRIPTION OF CENTRAL OREGON.

The section commonly known as central Oregon covers about one-third of the State. It includes the southern half of that part of Oregon lying east of the Cascade Range (fig. 1). Its total area is about 26,000,000 acres, of which possibly 5,000,000 acres are arable. Probably 1,000,000 acres of the arable land can be irrigated eventually in some way. The area that must be dry farmed, if farmed at all, is therefore about 4,000,000 acres. The land that is fit only for range amounts to about 21,000,000 acres. At present, railroad transportation has barely touched the edge of this great area and comparatively few people are making their homes upon the nonirrigated lands.

TOPOGRAPHY.

Central Oregon is a region of great plateaus broken by wide, level valleys and low, well-weathered mountains or buttes, with few high mountains and few streams. Most of the tillable dry-farming land lies between elevations of 4,000 and 5,000 feet. Central Oregon lies in that division of the United States known as the Great Basin, from which there is no drainage to the sea. Both the water and the cold air from the mountains flow down into the valleys.

SOILS.

The tillable dry-farming soils of central Oregon probably can be described best as the valley silt loams, valley sandy loams, valley sands, and plateau fine sandy loams.

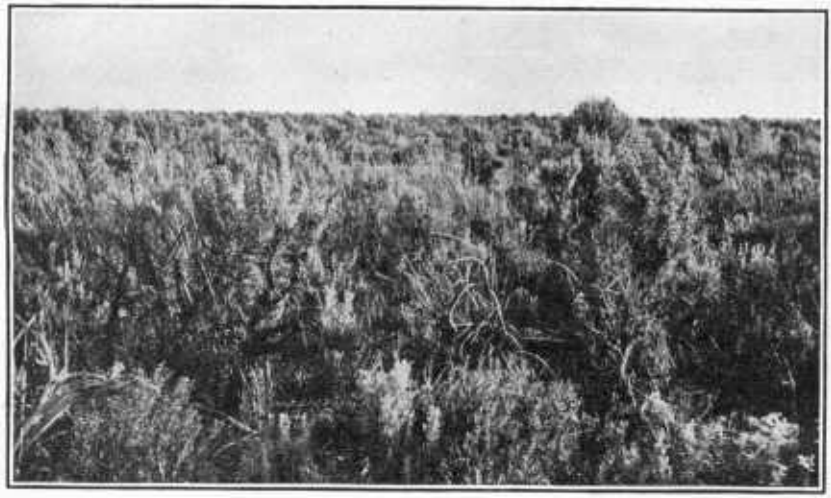

FIG. 2.—A vigorous growth of black sage in the Harney Valley in central Oregon, indicating fertility without excess of alkali.

VALLEY SILT LOAMS.

The valley silt loams include the heavier valley soils. They occur in practically all the valleys, large or small, and occupy probably about one-third of the entire valley area. Usually they are gray, brown, or black in color. The subsoil usually is quite heavy for a few feet, giving way to a more open soil at a depth of 6 feet or more. Hardpan may or may not be present. Water is found at depths of 10 to 200 feet, according to location. The native growth varies with the alkali content and other soil variations. A uniform growth of black sage (Artemisia), such as is shown in figure 2, is a fair indication of fertility without excess of alkali. Salt-grass (Distichlis), greasewood (Sarcobatus), and rabbit brush (Bigelovia) should be looked upon as a warning that injurious alkali may be present.

VALLEY SANDY LOAMS.

Those soils which are light enough to be tilled easily but not so sandy that they are moved much by the wind are classed as valley sandy loams. They occupy probably half of the total valley area. They are yellowish or brownish in color. The subsoil usually is somewhat heavier than the surface soil for a few feet and then becomes lighter, like that of the valley silt loams. The depth to water and the native vegetation, alkali content, and fertility are similar to those of the valley silt loams.

VALLEY SANDS.

The valley sands include those soils which are so sandy in character that they are blown about by winds. They are very easily tilled but otherwise difficult to handle. They comprise probably about one-sixth of the total valley area. The native vegetation, depth to water, and alkali content are similar to those of the other valley soils.

PLATEAU FINE SANDY LOAMS.

The plateau fine sandy loams, occurring on the hills and plateaus, are easily tilled, brown in color, and vary greatly in depth and subsoil condition. Water usually is not found before a depth of 100 feet is reached, and sometimes not within 300 or 400 feet of the surface. The native growth is principally black sage or black sage and bunchgrass. These soils are fertile and seldom contain much alkali. The important thing, aside from the variation in climatic conditions with locality, is that they be deep and without hardpan. There should be 3 to 4 feet of good soil to make these sandy loams suitable for farming.

CLIMATE.

The successful production of crops in central Oregon depends more on the climate than on any other factor, even though the altitude is not great and the Pacific Ocean not distant.

RAINFALL.

The average annual rainfall over the whole of central Oregon is about 11 inches. Most of this comes during the winter and spring months. Very little rain falls during the growing season. The rainfall varies markedly, however, even within short distances. Ordinarily, most of the moisture is absorbed by the soil, but there are times in the spring when the loss by run-off is great. This is true particularly on the valley silt loams and the steeper slopes of the plateau fine sandy loams. Sufficient moisture usually falls to produce

crops on good soil, well farmed, in a locality having rainfall that is average or better. Snow lies on the ground for three or four months during the winter in some localities, thus affording excellent protection for hardy fall-sown grains. In other localities the ground remains covered for only a short time.

EVAPORATION.

The average evaporation from a free water surface at the Harney Branch Experiment Station at Burns is about 45 inches for the months from April to October, inclusive. Wind and heat increase the loss by evaporation. Good tillage and early-maturing crops are measures against crop failure. Evaporation during the winter months is slight.

WIND.

The average velocity of the wind is only about 4 miles an hour. At the Harney Branch Experiment Station it is highest in the spring months. The highest average velocity recorded at Burns for a 24-hour period in 1915 was 14.4 miles an hour on April 30. High winds, though not frequent, do considerable damage on the valley sandy soils by destroying young crops, cutting them off, blowing them out, or burying them when the sand moves with the wind.

TEMPERATURE.

The average daily mean temperature is about 44° F. This average daily mean temperature is from 5 to 10 degrees lower than that of the Columbia Basin, about 3 degrees lower than that of the Palouse section of eastern Washington and western Idaho, and from 2 degrees to 4 degrees lower than that of the Snake River basin of southern Idaho. It is about the same as the average daily mean temperature of eastern South Dakota and southern Minnesota. The average daily minimum temperature is about 27°, and the average daily maximum about 60° F. The highest summer temperature is rarely as much as 100° F., and the lowest winter temperature is rarely lower than −25° F. The days in summer are warm, but pleasant; with few exceptions the nights are cool.

The greatest problem in farming in central Oregon lies in the frequency of summer frosts. Except in favored places, summer frost rarely, if ever, fails to occur in June. It sometimes occurs in July, and seldom fails to occur before August 20. The favored places referred to are creek canyons and the slopes of hills where good air drainage is afforded or where the temperature is moderated by nearness to bodies of water. The average length of the growing season for such crops as corn is 40 to 50 days except in the comparatively small favored localities. Some crops are much hardier and under good management usually can be grown without serious damage.

AGRICULTURAL HISTORY.

The early settlers in central Oregon were stockmen. They selected land upon which wild grasses could be grown for hay to winter the stock that grazed on the ranges during the rest of the year. The ranges were overstocked and the native grasses were grazed so closely that they were largely destroyed. The annuals could not mature sufficient seed to reseed themselves, and the perennials were trampled out or pulled up. Reductions in the number of stock on the range came as the natural consequence.

The overgrazing of the ranges was followed by an influx of new settlers, who began fencing much of the range lands for dry farms. These new settlers did not engage in stock growing, but put their dependence on grain production. They were poorly equipped for

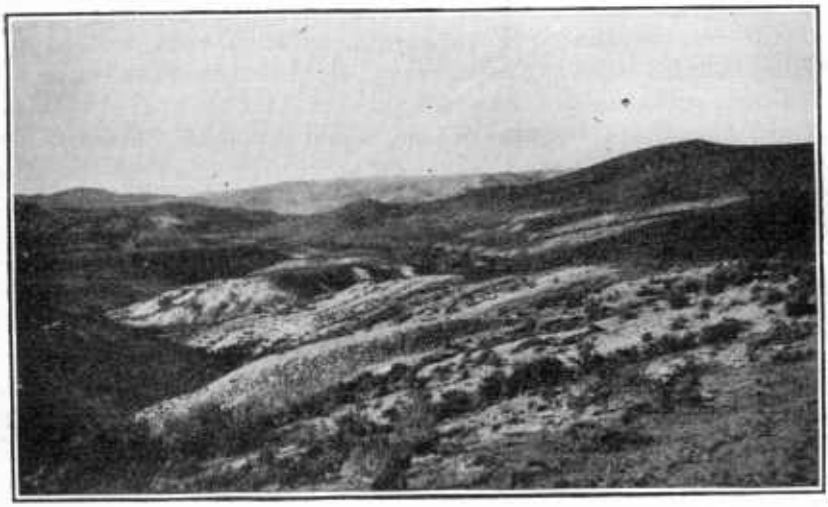

FIG. 3.—Mountain and hill land in Malheur County, Oreg. For every acre of tillable land in central Oregon there are many acres of this land that will always be range.

farming. The cost of living and of crop production far from railroads was high, climatic factors were adverse, and rodent pests were numerous. Many settlers attempted to produce grain without putting the land in shape to make production possible. They failed, but the range had opportunity to regain much that it had lost.

AGRICULTURAL POSSIBILITIES.

To-day the once boundless ranges of central Oregon are broken by the fences of settlers and by the remains of fences whose builders have gone. The day of the stockman who ranged his stock on a thousand hills and valleys is passing. With it is passing also the day of the man who depended on grain farming alone. It is a region of much Government land awaiting settlement, of much cheap

deeded land, and of great areas of reviving range land. The day of the small stockman-farmer is at hand.

Transportation has not yet and may not soon come within practical hauling distance by wagon of most of this land. Even when it does, it is doubtful whether grain farming alone will be a profitable form of agriculture over most of this section. For every acre of land that can be cultivated there are many acres of range land (fig. 3). Any system that does not utilize both the tillable land and the range can hardly be fully successful.

Dry farming, to be successful, must be done right, and the ranges must be brought under control so that they can not be destroyed by overgrazing. With adapted crops of good varieties, with correct methods of production in use on the tillable lands, and with some system of controlled or rotation grazing for the range, central Oregon will produce many times as much wealth in live stock as it has in the past.

EQUIPMENT NEEDED FOR GRAIN GROWING ON DRY LANDS.

A farmer may buy more machinery than is needed or he may get the wrong kind or not buy enough. The average farmer should depend upon horses rather than engines for power. Horses can be kept quite cheaply if grazed on the range, and the value of colts may make them a real asset rather than an expense. The delay and expense of getting repairs and the high cost of fuel, due to the necessity of a wagon haul of 100 to 200 miles from the railroad, make traction engines a questionable investment at the present time for the average dry farmer in central Oregon.

Every farmer should have a plow, a disk harrow, a spike-tooth harrow, and a drill. The disk plow often is better than one of the moldboard type for central Oregon land, because it works better through the sticky spots. Disk plows also are better for plowing dry land. However, the type of plow which is most desirable depends to a considerable extent on the locality. The machinery in successful use in a neighborhood is a good guide in buying. The double-action disk harrows are best, the cutaway type being good where the land crusts badly. Any well-made spike-tooth harrow is good. A spring-tooth harrow mounted on high wheels and equipped with interchangeable teeth and teeth points can perhaps be substituted for both the disk and spike-tooth harrows on the average farm. The single-disk drill is better for trashy land and the double-disk and hoe drills for clean land.

Often several farmers can combine in buying the more expensive machinery, thus lessening the individual expense. Sometimes, also, it is cheaper to hire machinery from another farmer or to pay him to do certain work than to buy expensive machinery which will seldom be used.

ROTATION OF CROPS.

In planning a crop rotation for dry-farmed land in central Oregon, two questions should be kept in mind: (1) What combination of crops will give the greatest immediate return? (2) What will be the effect upon soil moisture, fertility, and future crops? If only the immediate return is considered, those crops should be chosen which are best adapted to the individual farm, and they should be sown in the order that will give the greatest return at the least cost. While it is important to have the permanent productiveness of the soil in mind, immediate profit is far more important to the average dry farmer in central Oregon under present conditions.

The desire for present profits, however, should not cause one to lose sight of future possibilities. To maintain the fertility of the soil, the rotation should include nitrogen-gathering crops, like peas, alfalfa, and sweet clover. If the immediate profit is about equal to that from a rotation including cereals only, no one can afford to omit the legumes.

In the selection of a rotation the individual farmer must consider: (1) The product which will pay best, whether hay to feed range stock in winter, grain to sell, or both; (2) the crops most likely to give the greatest quantity of the products wanted; (3) the order in which these crops shall follow each other; and (4) the tillage which shall be given the land.

No rotation practice can succeed on these lands if it does not include clean summer tillage. Whether this summer tillage must be given every other year or only once in three or more years has not yet been demonstrated fully. However, it is known that on the average the second grain crop after the summer fallow will be light. Usually it will be a failure. A cultivated crop or a very early maturing cereal which may be cut for hay if it fails to make grain might do. More information must be obtained before any cultivated crop can be recommended generally. Only those rotations are discussed, therefore, which include summer fallowing once in two or three years.

As already stated, the grain-producing crops adapted to central Oregon in general are wheat, rye, oats, and barley, with peas as a possible leguminous seed crop. The crops important for hay are rye, wheat, and oats, in the order named, with field peas and sweet clover as possible leguminous hay crops suited to short rotations. Alfalfa can not be considered in short rotations, for the reason that it should be kept on the land several years when a stand is once established.

TWO-YEAR ROTATIONS.

The 2-year rotation, fallowing half the land each year and cropping the other half, is the safest for the farmer who grows only one crop, whether wheat, barley, or oats. On a 320-acre farm the arrangement each year would be simply 160 acres of summer fallow and 160 acres of one or more of these crops. Where two or more crops are grown they should change places on the land the next time the land is cropped. In this way the same kind of crop might not be grown on the same field more than once in four or even six or eight years. Whether or not the 2-year is better than a 3-year rotation containing one year of fallow, one grain crop, and one hay or cultivated crop depends on many local conditions. It can not be answered fully here.

THREE-YEAR ROTATIONS.

Under the 3-year rotation plan one-third of the land would be summer-fallowed each year, one-third cropped to grain following summer fallow, and one-third used for some crop sown on stubble land, double-disked in the spring. This plan has the advantage of requiring plowing only once in three years and also gives a greater acreage of crop each year. It is of doubtful value, however, because few crops will make a profitable yield following a grain crop in average years. A crop which will produce a fair yield regularly on the stubble land must be had, or the yields from 320 acres in a 3-year rotation may be less than from a 2-year rotation. If the total production is the same from each rotation the labor cost also will be about equal. The best plan, then, is the one which gives the greatest average total product from the land.

The crops suited to follow the grain crop in the 3-year rotation must either mature early or be capable of intertillage, or both. Those which may be used in this way are rye, field peas, and possibly sweet clover. Spring rye or winter rye sown very early in spring is preferable to fall-sown rye on stubble land. Peas and sweet clover, if it is possible to grow them profitably, would give a leguminous crop, and the peas a cultivated crop as well.

For the grain farmer, the best 3-year rotation apparently is one-third fallow, one-third wheat, rye, oats, or barley sown on summer fallow, and one-third spring-sown rye on disked grain stubble. If peas for seed can be grown, a portion or all of the well-disked or fall-plowed stubble land can be sown to this crop, thus changing the kind of crop from time to time. For farmers who want hay only, the choice of crops would be the same, except that sweet clover might possibly be used. The farmer desiring both hay and grain may use any combination of the suggested crops suited to his needs, his soil, and his climatic conditions.

PREPARING THE LAND FOR GRAIN.

CLEARING AND PLOWING.

The ordinary sagebrush land of central Oregon can be cleared during the summer months at a labor cost of about $2 per acre. This is done by the use of a drag drawn by six or eight horses. The brush usually is dragged both ways and then burned where it falls. If the brush can not be burned in this way, it is raked into windrows with heavy sagebrush rakes. Clearing by hand costs about $5 per acre for labor, except when the brush is dry enough to burn as it stands. The first plowing should be done as soon after clearing as possible, in order to prevent new growth and to make the period for the storing of moisture as long as possible. The labor cost of breaking land in central Oregon is $2.50 to $3 per acre.

When stubble land is to be plowed, the work usually should be done in the fall or early in the spring. To delay plowing until late spring or summer allows the weeds to grow, and the moisture needed for crops is lost. When plowing can not be done early, disking as soon as possible in the spring will assist in holding moisture. The depth of plowing should be varied slightly from year to year. The land need not be plowed oftener than once in two years if other tillage, such as disking, is substituted. On very light soils and with certain cropping systems discussed elsewhere in this bulletin, plowing may be done only once in three years when other efficient but less costly tillage operations are performed.

SUMMER FALLOW ON SUMMER TILLAGE.

The dry-farming soils in central Oregon can not be cropped to grain continuously. This has been well demonstrated through experiment and farm experience. If a crop is grown on the land every year, the return will not be sufficient to pay the cost of production except where there is seepage from higher slopes or in years of unusually heavy rainfall. It has been shown, however, that paying crops can be grown by cropping the land one year in two. The other year is devoted to accumulating moisture and fertility by means of the summer fallow.

At the Harney Branch Experiment Station spring wheat has produced an average yield of 6.5 bushels per acre by continuous cropping in a 4-year test. This was produced at a net loss of $1.65 per acre per year. In arriving at this figure it is considered that the wheat was worth 75 cents per bushel at the farm and that the cost of production was $6.55. The experiment showed that when the land was summer-fallowed every second year the average crop harvested was 16.5 bushels per acre. Using the same values but increasing the cost of production to $9.80 to cover summer tillage, the

higher harvesting and thrashing cost, and another year's interest and taxes, there remains a net gain of $2.57 for each acre cropped. On a 320-acre farm the returns under the first method would be $528 less than cost per year. Under the second method, where one-half the land is in crop each year, the returns are $411 per year above the cost of production, a difference of $939 per year in favor of the second method.

Summer tillage should prevent all weed growth and keep the soil surface rough and loose (fig. 4). This allows rain to be absorbed and prevents loss by run-off and evaporation. Stubble land should be plowed in the fall or early spring. Fall-plowed land and land that can not be plowed until late in the spring should be disked in early spring if possible, and then tilled with disk, spring-tooth, or

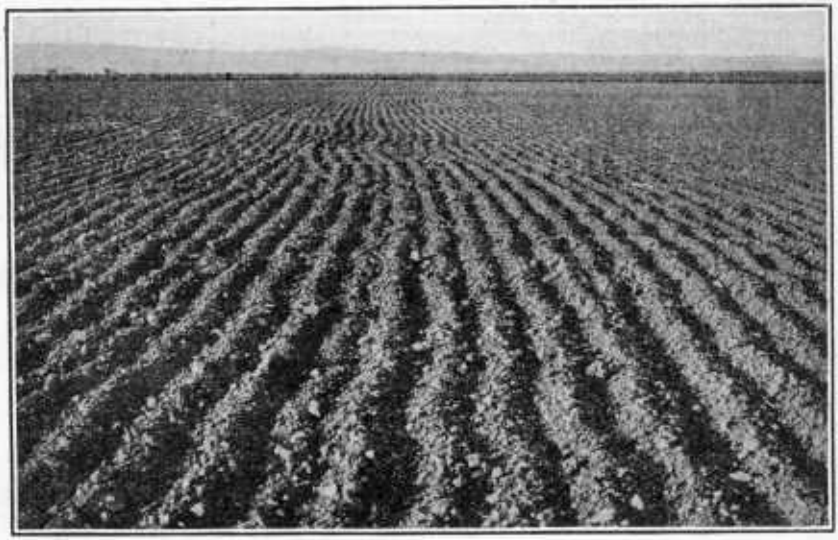

FIG. 4.—A perfect summer fallow, free from weeds, and with the surface soil rough and loose.

spike-tooth harrow only as necessary to prevent weed growth and keep the surface soil in good tilth. A loose, cloddy surface is ideal. A dusty mulch blows, prevents ready absorption of rain, and crusts. Wherever possible, plow at right angles to a slope. The seeding of fall crops usually can be done without extra preparation of the fallow. If the soil has become badly crusted it will be necessary to disk in the early spring before seeding spring grain.

GOOD SEED.

The value of good seed can not be overestimated. To be good, seed must be of good quality and free from weed seed and shriveled kernels. It must be of a variety which is adapted to the soil and cli-

matic conditions of the region, possessing earliness and hardiness. It must give the highest possible yield of the best quality. It must also be as free as possible from disease. A few additional cents per acre for good seed usually will be returned many times in the value of the crop. Specific statements as to varieties of the various grains which are adapted to this section and as to the best rates and dates of seeding are made in the discussion of the individual crops in the later pages of this bulletin.

TREATMENT OF SEED FOR SMUT.

Seed grain, unless definitely known to be free from smut, should be treated with a formaldehyde solution before seeding. The usual

FIG. 5.—Jack rabbits brought together in a drive near Burns, Oreg. Although more than 20,000 rabbits were killed at this place, apparently just as many as ever were present when the crops were ready for harvesting the following summer.

strength is 45 gallons of water to 1 pound of 40 per cent formaldehyde. The cleaned grain may be treated by sprinkling and shoveling until each kernel is moist. It may also be dipped and the smut balls skimmed from the surface of the liquid after stirring the grain to allow the smut to rise.[1] In either case the grain should be dried as quickly as possible. Care should be taken not to infect the seed again by using sacks or drills that have not been treated with formaldehyde. Always buy formaldehyde of standard strength, such as is supplied in sealed bottles.

[1] For a more complete discussion of the formaldehyde treatment for grain smut, see Farmers' Bulletin 507, "The Smuts of Wheat, Oats, Barley, and Corn," a copy of which may be obtained free on request to the Secretary of Agriculture, Washington, D. C.

PESTS.

Jack rabbits and ground squirrels, locally known as sage rats, are the most common animal pests in central Oregon. These pests are numerous enough to do great damage to growing crops in some localities. Many methods of killing jack rabbits have been tried, with different degrees of success. Poisoning is effective when carried on extensively over large areas during the winter months. Rabbit drives, trapping, shooting, and snaring are seldom effective, because they are not conducted on a sufficiently large scale to affect materially the total number of rabbits. Some idea of the number of rabbits in this section can be gained from figure 5, which shows a portion of those brought together in a drive at Burns. The bounty plan has been tried in two or more counties in central Oregon with

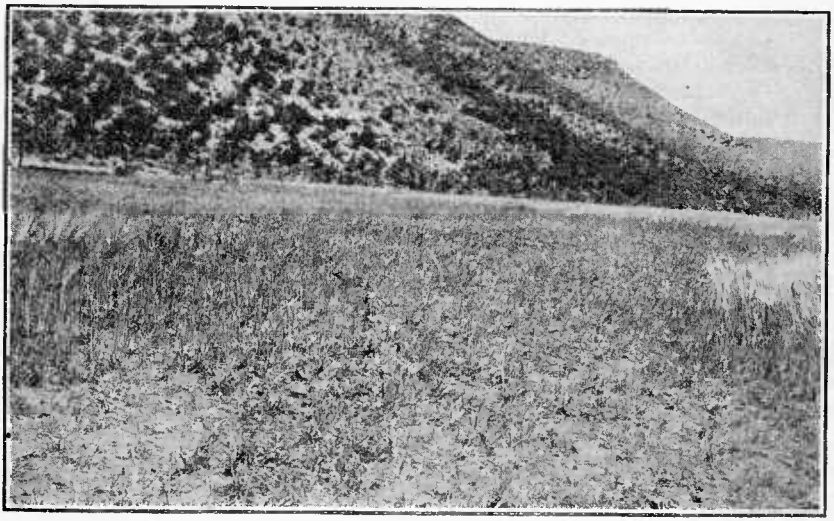

FIG. 6.—Grain field damaged by ground squirrels, locally known as sage rats. The early and liberal use of poison is the best insurance against loss of this kind.

partial success but at considerable cost. Whatever plan is adopted, it should be prosecuted vigorously and on an extensive scale. A single county is small enough for an effective unit. It would be much better if all the counties would combine on a plan. When the pests are reduced in numbers the efforts should be much increased rather than discontinued. A fight of this kind will cost a great deal, but the money will largely be returned in increased crops. Every interest in central Oregon would be benefited, for the eradication of this pest would mean much in the development of farming and the restoration of the range. Until the jack rabbits are eradicated the only safety for growing crops over much of the territory is in fencing with rabbit-proof wire. This wire fencing should be not more than 1¼

inches between line wires in the lower foot, 1½ inches in the next 6 inches, 2 inches in the next 6 inches, and 2½ or 3 inches in the upper foot of a fence 3 feet in height. A closely barbed wire should be sunk in the ground about 2 inches, to prevent digging under. The fence then should be placed over it, with the lower wire tight to the ground. Two barbed wires above the woven wire, one of which should be quite near it, will make the fence effective against stock. Such a fence will often pay for itself within a short time in crops saved, especially on the more isolated farms.

The work of sage rats in a grain field is shown in figure 6. These pests can best be kept in check by the use of poisoned grain. The following formula is recommended by the Bureau of Biological Survey:

Strychnin alkaloid (powdered)	1 ounce.
Baking soda	1 ounce.
Gloss starch paste (thin)	1 pint.
Corn sirup	One-fourth pint.
Glycerin	1 tablespoonful.
Saccharine	1 teaspoonful.
Oats	20 quarts.

Mix the powdered strychnin, soda, and paste to a smooth, creamy mass. Stir in the sirup, glycerin, and saccharine. Apply to the grain and mix until each kernel is coated; then dry the product. Keep all occupied burrows on the farm and adjoining lands supplied once every week by scattering about one teaspoonful of the poisoned grain about each opening. The use of larger quantities is wasteful and is also dangerous to live stock. Early poisoning is very important. A cheap effective poison liberally used will do much to keep this pest in check.

At the present time insect pests are not a serious problem in central Oregon. Those which occur occasionally in sufficient numbers to cause damage to crops are cutworms and grasshoppers.

Cutworms may be destroyed when they appear by sowing poisoned bran mash late in the evening along the borders of the area eaten down. The following formula for preparing poisoned bran mash is taken from Farmers' Bulletin 739 of the U. S. Department of Agriculture: Mix 50 pounds of wheat bran, 2 pounds of Paris green, and 6 finely chopped oranges or lemons. Then bring the whole mixture to the consistency of a stiff dough by the addition of low-grade molasses, such as is used for feeding to cattle, adding water when necessary. Distribute this bran over the infested field in small lumps. If bran can not be obtained readily, middlings or alfalfa meal may be substituted.

When grasshoppers become numerous, they may be destroyed by using a similar poisoned bait composed as follows: Wheat bran, 25

pounds; Paris green, 1 pound; white arsenic, 1 pound; lemons or oranges, 6 finely chopped fruits; low-grade molasses or "blackstrap," 2 quarts. Ordinary table sirup should not be used for this purpose, as it is not attractive to grasshoppers. In the dry-land regions, water should be added to this bait at the rate of 4 gallons to 25 pounds of the mixture, as the extra moisture is necessary in order to attract the grasshoppers. It is also important to distribute this bait in the late afternoon or early evening, just before the grasshoppers ascend the plants on which they usually pass the night.

SMALL-GRAIN CROPS.

WHEAT.

Wheat is the best yielding grain crop to grow on land alternately cropped and fallowed in central Oregon on soils adapted to its culture. The valley silt loams, the plateau fine sandy loams, and, to a less extent, the valley sandy loams, are most suitable.

WINTER WHEAT.

Under proper conditions winter wheat will outyield all other cereal crops. While worthy of trial elsewhere, it is particularly adapted to the valley silt loams and the plateau fine sandy loams, but only in localities where snow lies on the ground throughout the winter and where frosts do not occur too regularly in late June and in July. Yields should average about 20 bushels to the acre on land previously well summer-fallowed. Yields, however, will vary greatly from year to year, according to the damage done by frosts during the time of heading and filling.

The Turkey winter wheat is best adapted, because of its hardiness, good yields, and the high quality of the grain for milling purposes. Seeding should be done on summer fallow at the rate of about 30 pounds of good seed per acre. Drill rather shallow about September 10 if the soil is moist enough to sprout the seed. The wheat should make a good start in the fall if it is to survive the winter in good condition. If the soil is dry, it may be better to sow spring grain, though very late fall seeding will sometimes succeed. Harrowing in the spring after growth has started well may help the crop under some conditions and may hurt it under others. Soil types and seasons vary so much that this question must be settled by each farmer for himself.

SPRING WHEAT.

Spring wheat is probably the most consistent yielder of all the grain crops where soils and climatic conditions are suited to its production. The crop is adapted particularly to the valley silt loams,

the plateau fine sandy loams, and the heavier portions of the valley sandy loams. It is less likely to be injured by frost than winter wheat, because the period of heading and ripening comes later in the summer and does not last as long when early varieties are used. Sown on good summer fallow, it may be expected to average 15 to 20 bushels per acre. As a hay crop it hardly equals rye in yield under average conditions. The best variety now known for central Oregon is the Early Baart, which combines earliness with drought resistance and a high average yield of excellent milling wheat. Still better varieties may be found, but at present no mistake can be made in growing the Early Baart. For hay the Palouse Bluestem may be preferable, because it is beardless.

A spring-wheat variety must mature early to be adapted to extensive cultivation in central Oregon. Late varieties are frosted repeatedly before maturing; this results in low yields of shriveled wheat which produces flour of inferior quality. Good, plump wheat is necessary in order to assure a market.

It is poor policy for a community to grow a large number of varieties. If all farmers grow the same variety, the product will be more uniform, with consequent benefits in price.

Spring wheat should not be drilled deeper than is necessary to place the seed well into moist soil. Sow about April 15 to 20 at the rate of about 30 pounds of good seed per acre. It is not advisable to harrow the crop after it is up.

EMMER AND SPELT.

Winter emmer and spelt are not adapted to central Oregon conditions, because neither is hardy enough to survive the average winter. Spring emmer can be grown and will make fair yields, but it is not as good either in yield or in value per pound as wheat, oats, or barley. Until emmer and spelt have been tested more thoroughly, they should not be grown in this region unless in an experimental way.

RYE.

Rye is the principal crop now grown on the dry-farming lands of central Oregon. Probably it will continue to hold first rank in acreage for a long time, though wheat may yet outrank it in total production of grain.

WINTER RYE.

Winter rye is the only type of rye now grown in central Oregon to any considerable extent. The crop is sown both in the fall and in the early spring. When sown in the fall under proper conditions it usually survives the winter very well and makes an early growth in the spring. This earliness, however, unless checked by pasturing,

very frequently results in the loss of part or all of the grain yield because of the frosting of the heads. When the crop is to be harvested for hay, this fact is slightly less important. When winter rye is spring sown, the development is slower and good yields of both grain and hay are more uniformly obtained than from the fall-sown winter rye. However, if sown in the spring, it must be sown very early or it will not succeed. If sown at the usual time of sowing spring grains, it will rarely get beyond the stooling stage except in unusually wet and cool summers.

As a fall-sown crop, winter rye is adapted particularly to the valley silt loams and plateau fine sandy loams where June and July frosts are rare and where there is usually a winter covering of snow. Under these conditions on well-fallowed land it may be expected to yield 12 or 15 bushels of grain or 1½ to 2½ tons of hay per acre. Where wheat is the first crop sown after fallow, rye is better than other cereals to sow on the disked stubble land if such a practice is adopted. Seeding should be done about September 10 to 15 at the rate of 30 to 60 pounds of good seed per acre.

Winter rye sown in early spring will succeed under nearly all soil and climatic conditions in that part of central Oregon under discussion where any grain crop would succeed. However, it is not always possible to seed it early enough and a delay of one or two weeks often results in failure. As good average yields may be expected as from fall-sown winter rye under like soil conditions. Since a winter covering of snow is not essential with spring-sown winter rye, it may be grown over a much wider area. It should be shallow drilled not later than April 1 at the rate of 30 to 60 pounds of good seed per acre.

The value of rye grain for feeding purposes is not quite equal to that of wheat, barley, or oats, pound for pound. It usually sells on the market, however, for about as much per pound as wheat. As a hay crop for wintering stock from the range, the value of the hay will be in proportion to the number of stock that the grower can winter on the product of his farm. Under good management the hay might bring the grower as much as $7 to $8 per ton when fed on the farm.

SPRING RYE.

Little or no true spring rye is being grown in central Oregon. True spring rye develops very rapidly when sown in the spring. It does not stool as much as winter rye and makes a shorter and finer growth of straw. The grain is also somewhat smaller than that of winter rye.

Spring rye is being tested at the Harney Branch Experiment Station, but the trials have not been conducted long enough to warrant a positive statement as to the usefulness of the crop in that locality.

So far as soils and climate are concerned it is adapted to as much of the dry-farming area of central Oregon as any grain crop. Its value will probably be greatest on the lighter soils and as a grain or hay crop on disked wheat stubble when the wheat follows fallow. Yields of hay and grain may be expected to be as good as or slightly better than those of early spring-sown winter rye. The crop should be drilled about April 20 at the rate of 30 to 60 pounds of good seed per acre, placed as shallow as possible to get the seed well into moist soil.

OATS.

The cool climate of central Oregon is favorable to oats, but the crop is not so drought resistant there as wheat. As a producer of grain in pounds per acre, oats may be expected to rank second to wheat under average conditions upon fallowed land. Where oats are needed at home, there is reason for growing the crop. As a market crop or as a feed crop for fattening meat animals, it does not have as high a value per pound as wheat.

WINTER OATS.

Winter oats will not survive the ordinary winter in central Oregon. Sown in the spring it is doubtful whether the yield would be as good on the dry lands as that from a good spring variety.

SPRING OATS.

Spring oats are best adapted to the valley silt loams. In seasons of favorable summer precipitation they will do well on the valley sandy loams and plateau fine sandy loams. When an early variety is seeded after April 15 heading does not occur till July and the crop is mature before August 10, so that little damage from frost is likely. On the soils adapted to the crop an average yield of about 30 bushels of grain per acre may be expected on summer-fallowed land. As a hay crop an average of 1 to 1½ tons per acre would probably be harvested.

The early small-kerneled Sixty-Day variety of oats is recommended for dry-farmed lands in central Oregon, especially for the production of grain. Seeding should be done from April 15 to 20 at the rate of 1 bushel of well-cleaned, plump seed per acre, drilled as shallow as possible, but placed well into moist soil.

BARLEY.

Barley is probably less adapted to central Oregon dry-farming lands than wheat, oats, or rye. Barley will do very well where the soil is usually quite moist and in seasons of abnormally heavy summer rainfall. Present information indicates that on the average it is

not nearly as good as wheat for the production of grain and is slightly less valuable than oats.

WINTER BARLEY.

Winter barley will not survive the average winter in central Oregon. When it survives, June and July frosts usually catch the crop in head. When spring sown it has not given as good results as good spring varieties.

SPRING BARLEY.

The importance of spring barley lies principally in supplying special local demands. Sold on the market, it usually brings less per pound than wheat or oats. Fed to fattening meat animals, it is about equal to wheat in value per pound. The crop is adapted to the valley silt loams particularly and can be grown on lighter soils when the summer rainfall is favorable. Barley is subject to frost injury, requiring late seeding to prevent heading before the last spring frosts. An average grain yield of 18 to 20 bushels per acre may be expected on summer-fallowed land where the soil is adapted to the crop.

The White Smyrna variety is probably the best adapted to the average central Oregon dry farm. This variety is very early and of good quality. Its short straw is an advantage from the standpoint of grain production. Seeding should be done about May 1 at the rate of 40 pounds of good seed, drilled as shallow as possible, but deep enough to place the seed well into moist soil.

FLAX.

The growing of the flax crop is yet in the experimental stage in central Oregon. Experiments conducted during the last three years indicate that it is quite frost hardy and that it is adapted to the heavier soil types. With improved transportation facilities, flax is a possible cash crop on soils adapted to its growth for use in rotation with other crops. A 3-year average yield of 6.6 bushels per acre has been obtained at the Harney Branch Experiment Station. The price per bushel on the farm may be expected to average from $1.25 to $1.50.

The best variety of flax to grow in this section has not yet been determined. Seeding probably is best done early in May at the rate of 16 pounds per acre, drilled shallow in a fine, firm, moist seed bed.

RANK OF SMALL-GRAIN CROPS.

Any ranking of crops adapted to central Oregon according to their importance must be qualified with the understanding that the ranking applies to the region as a whole. Under local variations of

soil, rainfall, frost, winter snow covering, transportation facilities, range conditions, actual products wanted, etc., the ranking given may or may not hold.

From the standpoint of grain production the adapted cereal crops rank in importance in the following order: Wheat, rye, oats, barley.

From the standpoint of yield and value when cut for hay the adapted cereal crops rank as follows: Rye, wheat, oats, barley.

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